Cataract Surgery optimizing outcomes

Cornea update

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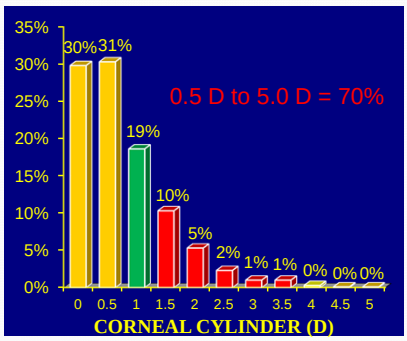
Cataract Surgery - Goal

- "Pushed" from a purely medical procedure to one of refractive surgery"
- Optimize outcomes – Post-op refraction within +/- 0.5D sphere and cylinder
- Reduce risk – "dropless cataract surgery"

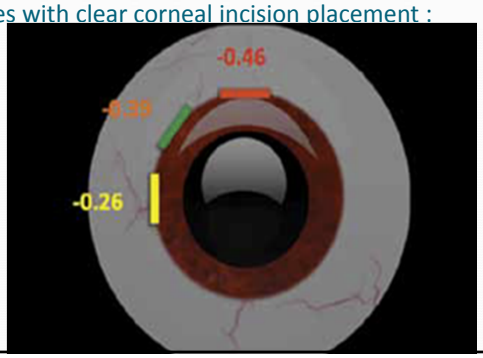
Prevalence of Astigmatism



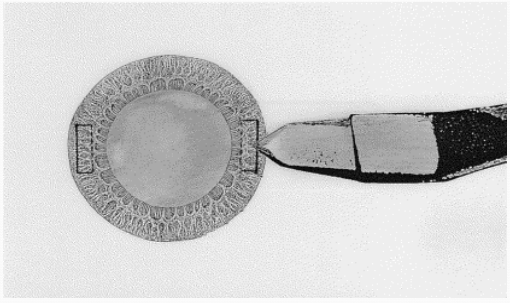
Astigmatism: Surgical Options

- Astigmatic Keratometry: Diamond knife or Femto
- Clear Cornea Incision on steep axis (single or paired)
- Limbal relaxing incision
- Scleral Recession

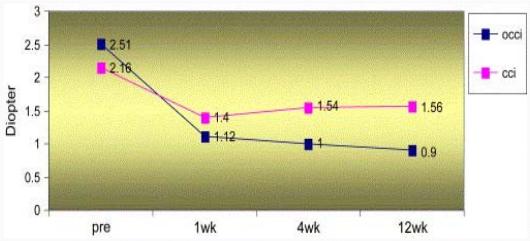
Astigmatism correction:
varies with clear corneal incision placement :



Paired Clear Corneal incision on steep axis 1.0 cylinder

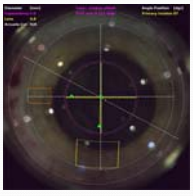


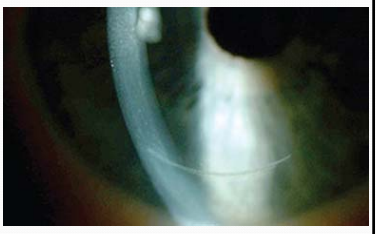
Astigmatic Keratotomy: Clear Cornea incision single vs paired



Astigmatism: Limbal Relaxing Incisions (LRI's) < 1.5D cylinder

Femtosecond - intrastromal





Femtosecond – 7mm OZ - Intrastromal 13

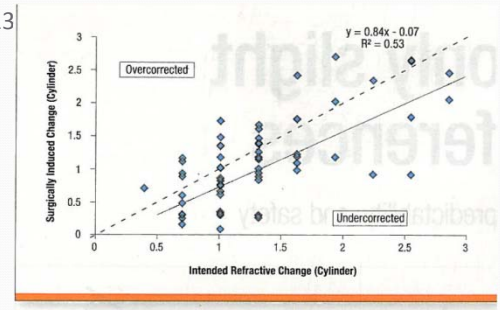


Figure 3 Three-month intended refraction change versus surgically induced refractive change.

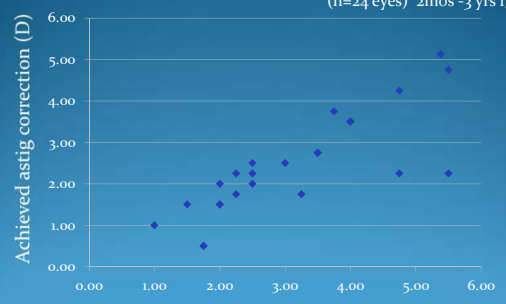
Scleral recession (modified scleral tunnel)for with the rule astigmatism 1.0D or greater

*3-7. **Shelf of the incision.** The shelf portion of the incision holds the iris back and helps prevent iris prolapse.*

Scleral Recession combined with cataract surgery

Pre-op vs post-op residual astigmatism

(n=24 eyes) 2mos -3 yrs f/u



Attempted Astigmatism correction (D)

LASIK or PRK (lamellar) with Cataract Surgery

Indications:

pre-op: astigmatism > 1.5 diopters
post-op: undesirable ametropia

Flap creation:

preferably make it pre-op
post-op: wait three months

CustomVue® treatment:

wait at least one month post cataract/ICL surgery

Wavefront guided LASIK

Wavelight (Alcon) vs Custom Vue (VISX)

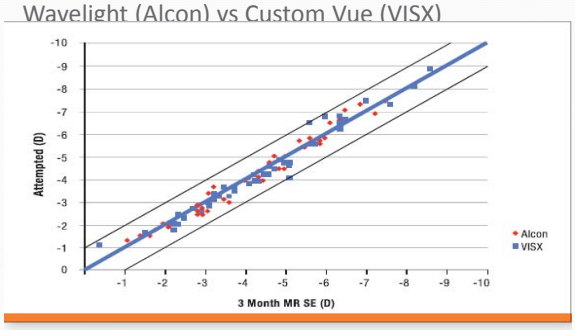


Figure 1 Predictability was excellent for both technologies.

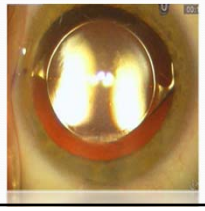
Hitting your target with Toric IOL's

- > = 1 Diopter
- AMO/Alcon 1-4d cylinder magnitude

TORIC IOL's

AMO

Alcon



Cylinder Powers

AMO Toric and Alcon AcrySof Toric SN6AT

Spherical Powers : 6.0 – 30.0 D

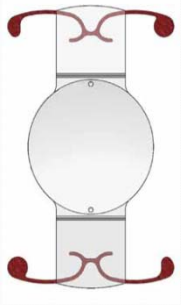
Model	Cylinder Power @ IOL Plane	Cylinder Power @ Corneal Plane*
ZCT150	1.5	1.03
ZCT225	2.25	1.55
ZCT300	3.0	2.06
ZCT400	4.0	2.74

Cylinder Powers
AMO Toric and Alcon AcrySof Toric SN6AT

Spherical Powers : 6.0 – 30.0 D

Model	Cylinder Power @ IOL Plane (D)	Cylinder Power @ Corneal Plane (D)
ZCT450	4.5	3.08
ZCT525	5.25	3.6
ZCT600	6.0	4.11

Accommodating IOL
Trulign Toric – Crystalens Cylinder: 0.83-1.83D



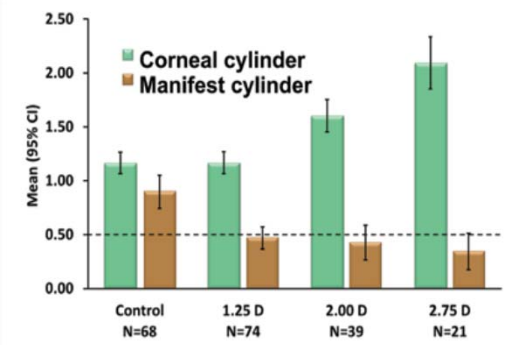
Trulign Toric

addresses TWO unmet clinical needs of cataract patients in one procedure:

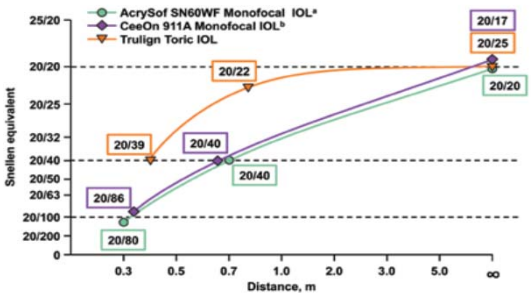
(1) reducing the visual impact of residual uncorrected astigmatism

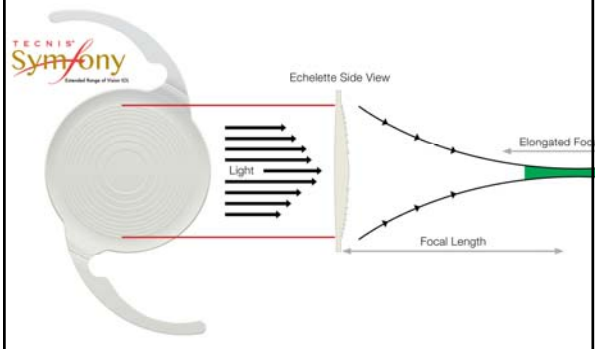
(2) uncorrected distance, intermediate vision and functional near vision.

Trulign Toric



Mean Distance-corrected vision at various vergences

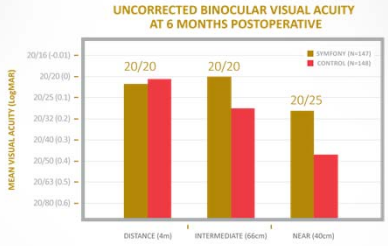




EXCELLENT DISTANCE AND INTERMEDIATE, GOOD NEAR

TECNIS Symfony

Uncorrected visual acuity at all distances



- Monocular Distance Corrected vision with TECNIS Symfony IOL improved 2.4 lines for intermediate vision and 2.2 lines for near vision compared to the monofocal control.

25

PP2016CTorpit

Symfony Toric – 97% satisfaction

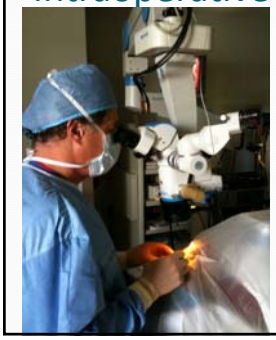
- Extended depth of focus
- 1-2.6 D cylinder (cornea plane)

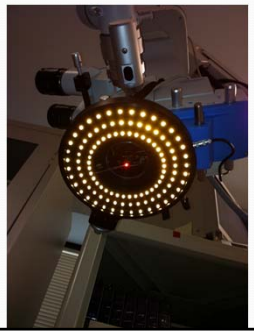
Multifocal IOL's

- AMO 2.0, 2.37, 3.0 D Adds
- ALCON 2.0, 2.5 D Adds
- ALCON Toric option available April 2017

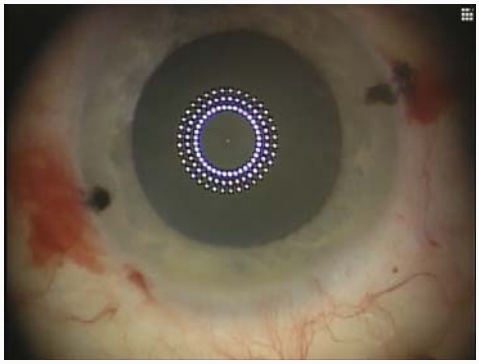
- Target: must be near plano, no cylinder.

Intraoperative Keratometer





Intraoperative Keratometer



How do we select "correct" power IOL?

IOL Formulas
1977: Refraction based

- add +19.0D to pre-cataract refraction

IOL Formulas
1979: Refraction based

- Emmetropic: 21.0D
- Myopic: 15D
- Hyperopic: 25D

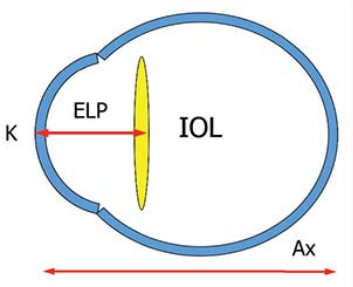
- Large lens power errors commonplace

IOL Formulas
1980's: Regression Formulas

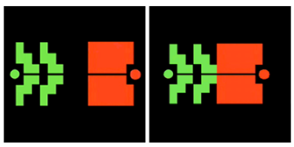
- Empiric formulas generated by retrospective analysis and averaging data from large number of patients after cataract surgery
- Improved refractive prediction

- Lens power errors were commonplace:

IOL Formulas: Keratometry and Ultrasound Biometry (solid probe and immersion)
1980's: Theoretical Formulas



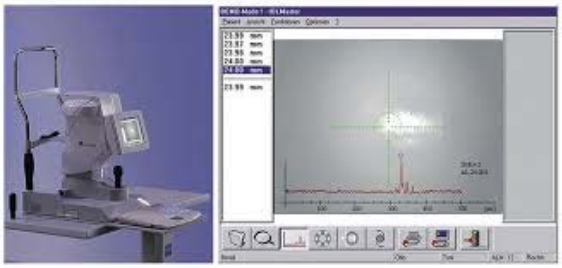
Manual Keretometry



IOL Formulas (Ultrasound Biometry solid probe and immersion)
Late 80's: Theoretical Formulas

- SRK T, Holladay 1, Hoffer-Q
- Axial Length and K's
- All require an estimation of the effective lens (IOL) position
- Refractive errors still occur
- Within +/- 1.00D of target sphere

Optical Biometry - IOL Master -2000 –partial coherence interferometry:
non contact – axial length 5x more accurate vs US



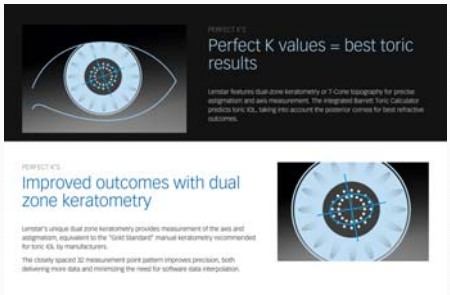
IOL Formulas (Optical Biometry) 2013 "Benchmark Standard"

- +/- 0.5D 70%
- +/- 1.00D 90%

IOL Formulas (Optical Biometry) 2017: Theoretical Formulas

- Holliday 2, Haigis, Barret Universal II, Olsen
- Axial Length, K's, Lens thickness, W-W, AC depth,
- All require an estimation of the effective lens (IOL) position
- Refractive errors still occur

Measuring Points:
32 (lenstar) vs 6 (IOL Master 500/700)



Barret Toric Calculator:

calculates estimated net corneal astigmatism (Anterior/Posterior Cornea)

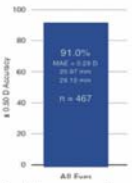
1. Posterior corneal surface is a minus lens: if steep vertically, creates power @ 180 deg
2. Estimates amount of posterior corneal astigmatism

Hill-RBF Calculator

- Selects IOL power using artificial intelligence-driven pattern recognition
- Does not depend on effective lens position

Hill-RBF Calculator

Results!



- 91.0% of the all 467 eyes were within 0.5 diopter of target.

Figure 2. The percentage of eyes within ±0.50 D target spherical equivalent with the Hill-RBF Calculator.

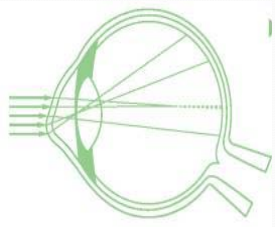
Enhancement options: INFORM IN ADVANCE OF CATARACT SURGERY!

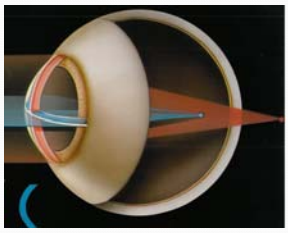
- Glasses/Contact lenses
- IOL Exchange
- Astigmatic Keratotomy – Limbal Relaxing incision
- Laser Vision Correction
- "mini" RK (one/two incisions)

Cornea 2017

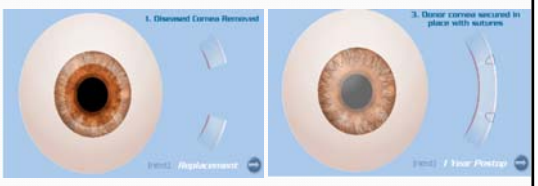
- What's New?

Astigmatism Irregular vs Regular

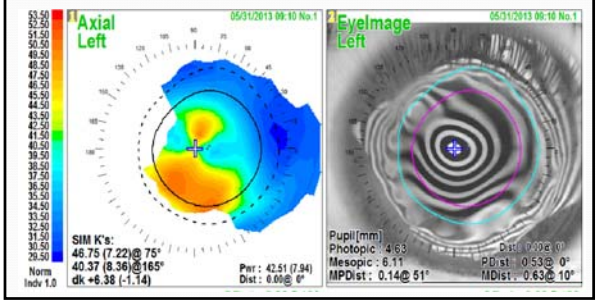




100 yrs : So what's wrong with Penetrating Keratoplasty (PK)?

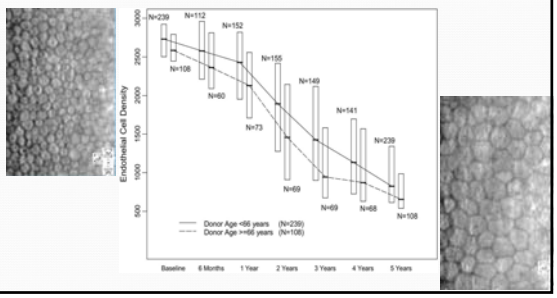


20 y/o PK 7.5mm – keratoconus suture in 1 yr after surgery



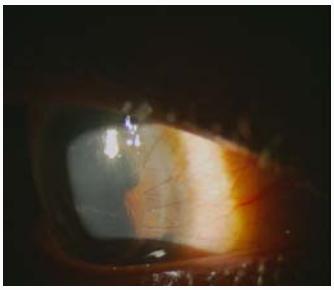
Cornea Donor Study

Ophthalmology 2008 - *Cornea Donor Study Investigator Group*



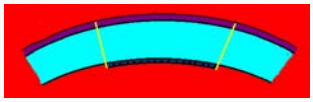
PK's don't always last a lifetime…

PK's – Scourges
Cornea Graft Rejection

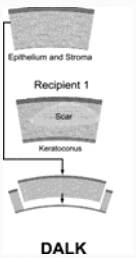


PK's – Scourges
Cornea Graft Rejection
Case report (ASCRS listserv)

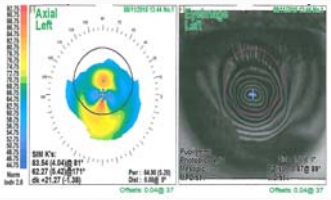
- 17 yo severe keratoconus, atopic dermatitis
- PK x 3
- Graft rejection/failure each time
- Immune suppression: cytoxan?
- Regraft?
- Keratoprothesis?



Deep Anterior Lamellar Keratoplasty (DALK) Challenge:

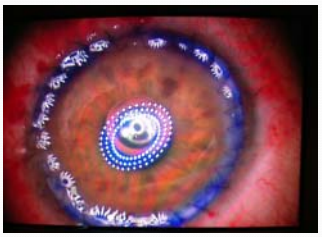


Severe Keratoconus with scar
hx of cornea hydrops – age 19



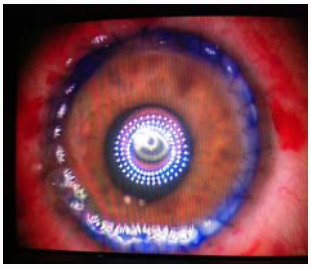
Intraoperative Keratometer

DALK/PK – before suture adjustment

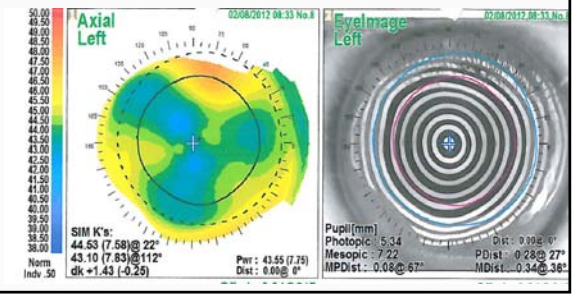


Intraoperative Keratometer

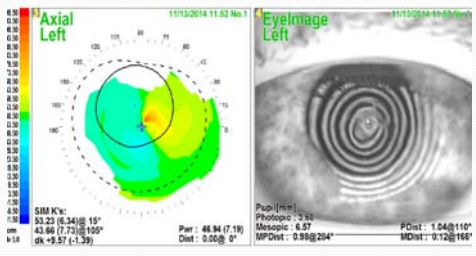
DALK/PK – after suture adjustment:
improves early optical rehabilitation



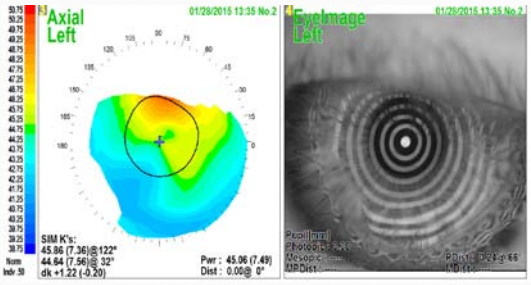
Severe Keratoconus with scar
20 yo 15 mos aft DALK suture out
- 5.0 + 0.5 x 20 20/20



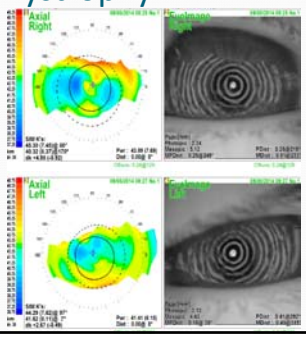
31 yo severe keratoconus/scar



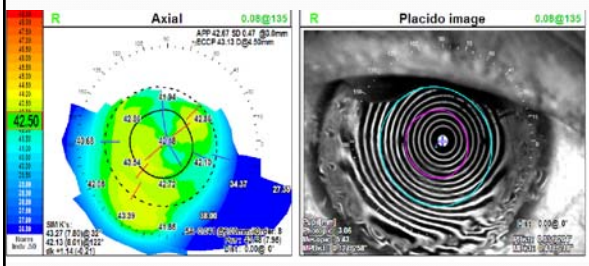
VERY Early visual rehabilitation
Large Diameter DALK (10mm dia)
-9.0 20/30 8 days post-op



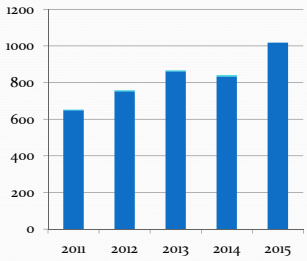
37 yo male Severe Reis Bucklers Cornea Dystrophy



37 yo male Severe Reis Bucklers Cornea Dystrophy 1 wk s/p DALK 9.5mm diameter 20/20 UNCORRECTED

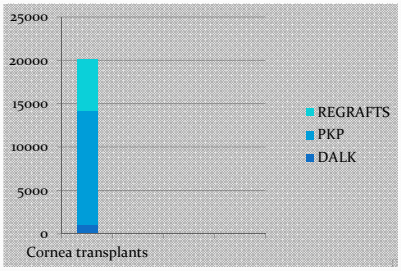


USA DALK vs PK 2011-2015

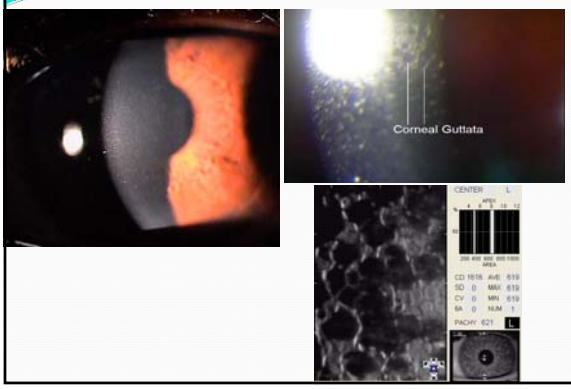


DALK vs PK - 2015

Are we conserving recipient endothelial cells during surgery and what is long term graft survival?



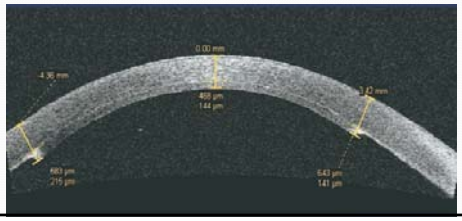
Fuchs' Corneal Dystrophy - 39% Transplants



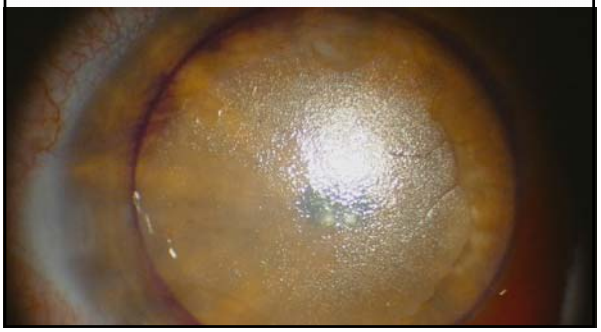
DSEK: IT it's so good, why change?

It's all about vision quality!

- 80% BSCVA 20/40
- Only 30% achieve 20/20



Fuchs' Corneal Dystrophy - 39% Transplants



DMEK:
Visual outcome @ 6mos (n = 221)

BSCVA:
- ≥20/40 98%
- ≥20/25 79%
- ≥20/20 46%
- ≥20/18 14%

Negligible refractive shift

Contact Lens & Anterior Eye - Melles
Volume 36, Issue 1 , Pages 13-21, February 2013

Graft Rejection after 2 yrs:
DMEK (400 eyes) vs DSEK vs PK

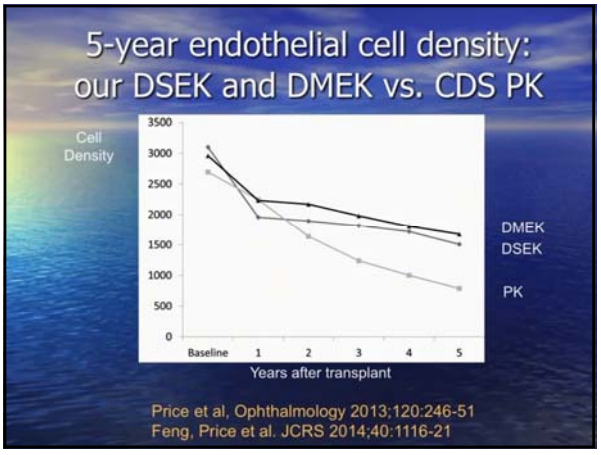
- DMEK 20x less than PK.
- DMEK 15x less than DSEK

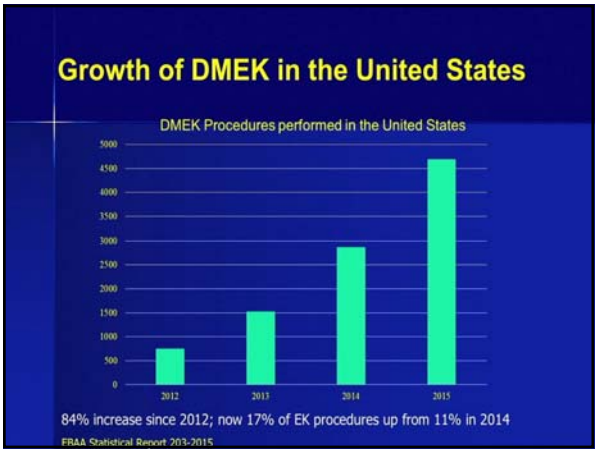
Ophthalmology 2012;119:536–540 Anshu, Price

Graft Rejection
DMEK >2400 eyes 3-4yrs aft surgery

- DMEK <1%

Price et al. DMEK Risk of Immunologic Rejection
Ophthalmology 2016





Cornea Transplantation USA 2015
Total Corneas 79,304

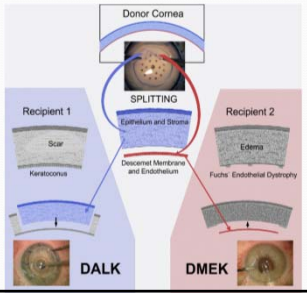
- 48,792 (vs 35,300 in 1995)
- 30,512 exported internationally
- 3.8 million cataract procedures

Cornea Transplantation - World 2012
742 Eye Banks reporting

- 184,576 transplants
- Performed in 116 countries
- Corneas procured in 82 countries
- 53% of worlds population have NO ACCESS to cornea transplantation!
- 12.7 million waiting for cornea transplantation

JAMA Ophth 2016:134(2) 167-173

One Donor = Two Recipients!!



One Donor = Two Recipients!!
Review of the First 100 Consecutive Patients

- Reduce cornea donor tissue shortage!
- Reduce cost

Am J Ophthalmol 2011;152:523–532 Heindl et al

Cornea Regenerative Medicine

- Cultivation of Human Cornea Endothelial Cell Cultures
- Transfer to the anterior chamber of the eye
- Restore endothelial cell counts